Inferred Sensors and Planned Resources: Modular Components for Autonomy-Aware Spacecraft Flight Software

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Abstract

Autonomy technology for system-lend spacecraft control architectures is a technology whose time has come in these bold, yet frugal, times at NASA. The advantages of autonomy technology for flight projects are numerous; perhaps the two most notable being reduced post-launch, ground operations costs and reduced brittleness in mission plans. However, as with any new technology, there are risks associated with technology insertion and given the traditional conservatism of spacecraft flight projects it can be difficult to achieve, throughout the mission, the full benefits offered by autonomy technologies.

We present two modular components, inferred sensors and planned resources, in an autonomy-aware spacecraft control architecture. Given these two components we show how two traditional autonomy technologies -. model-based reasoning (for spacecraft state) and planning (for resource conflicts) can be injected into spacecraft flight software in a non-pervasive, incremental fashion. The level of autonomy in the flight software is essentially dialable; the dial can be set by system engineers at design time or, given suitable configurability within the flight software, during flight as well. This dialability mitigates the risks associated by flight projects with autonomy technologies.

This paper should be of interest to autonomy technologists, flight software system architects and spacecraft system engineers.